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(54) **Aromatic carbonate resin exhibiting improved impact properties.**

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(73) Proprietor: **GENERAL ELECTRIC COMPANY**
1 River Road
Schenectady New York 12305(US)

(72) Inventor: **Boutni, Omar Mohamed**
1232 Oriole Circle
Mt. Vernon Indiana 47620(US)

(74) Representative: **Catherine, Alain**
General Electric France Service de Propriété
Industrielle 18 Rue Horace Vernet
F-92136 Issy-Les-Moulineaux Cedex(FR)

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Description

Aromatic carbonate resins are well known thermoplastic materials which due to their many advantageous physical and mechanical properties find use as thermoplastic engineering materials. The aromatic carbonates exhibit, for example, excellent properties of toughness, flexibility, and high heat distortion temperatures. The aromatic carbonates and methods for their preparation are disclosed, inter alia, in U.S.-A-2,964,974, 2,999,835, 3,169,121, 3,028,365, 3,334,154, 3,275,601 and 3,915,926.

However, these aromatic carbonates generally suffer from low critical thickness values, i.e., the thickness at which a discontinuity in Izod impact values occurs. These low critical thickness values tend to limit wall thickness of molded articles to a thickness below the critical thickness. The aromatic carbonate resins exhibit notched Izod impact values which are dependent on the thickness of the resin article. Thus, for example, while typical notched Izod impact values of one-eighth inch thick polycarbonate test specimens are generally in the range of about 16 foot pounds per inch, typical notched Izod impact values for a one quarter inch thick polycarbonate test specimen are generally in the range of about 2 foot pounds per inch. The relatively high Izod values of the one-eighth inch thick polycarbonate test specimens are due to the fact that these specimens are thinner than the critical thickness of the polymer and, therefore, upon impact a hinged or ductile break occurs. The low Izod impact values of the one-fourth inch thick polycarbonate test specimens are due to the fact that these specimens exceed the critical thickness of the polymer and, therefore, upon impact a clean or brittle break occurs.

It is well known in the art, and amply described in the patent literature, that the impact properties of aromatic carbonate polymers can be improved by blending an impact modifier with these aromatic carbonate resins. These impact modifiers include the polacrylates, polyolefins such as linear low density polyethylene, rubbery dienic resins such as ethylene propylene diene terpolymers, and styrenic resins. However, in order to significantly improve the impact properties of aromatic carbonate resins these impact modifiers must be present in relatively large amounts, e.g. typically at least about 4 weight percent based on the amount of impact modifier and aromatic carbonate resin.

It would thus be very advantageous if aromatic carbonate resin compositions could be provided which, while exhibiting substantially equivalent impact properties to those obtained using these relatively high loadings of conventional impact modifiers, did so utilizing lower concentrations of these impact modifiers. It is, therefore, an object of the instant invention to provide such aromatic carbonate resin compositions.

The instant invention is directed to aromatic carbonate resin compositions exhibiting improved impact properties. More particularly, the instant invention is directed to aromatic carbonate resins which are blended with an amount effective to improve the impact properties thereof of an impact modifier combination comprised of a polyolefin and an aliphatic sulphonate.

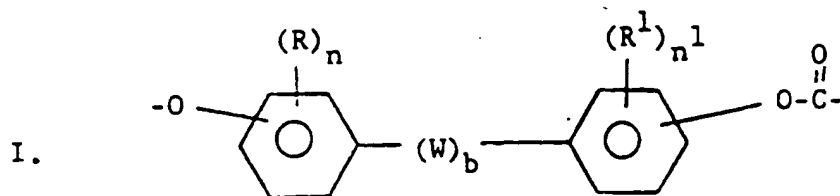
In accordance with the instant invention there are provided a composition comprising:

- (a) an aromatic carbonate resin,
- (b) 1 to 10% by weight, based on the total weight of (a) and (b) of a polyolefin, and
- (c) 0.5 to 2.5% by weight, based on the total weight of (a) and (c) of an anionic aliphatic sulphonate.

It has been discovered that the impact properties of aromatic carbonate resins can be positively upgraded by utilizing lower loadings of conventional impact modifiers than presently used by the incorporation into an aromatic carbonate resin composition containing at least one aromatic carbonate resin and a relatively low amount of polyolefin at least one anionic aliphatic sulphonate. The presence of relatively small quantities of this anionic aliphatic sulphonate results in the instant compositions exhibiting impact properties generally equivalent to polyolefin modified compositions which typically contain at least about 4 weight percent of polyolefin at lower loadings, e.g., 50% or less, of said impact modifier. The combination of the polyolefin with the anionic aliphatic sulphonate thus appears to have a surprising effect upon the upgrading of the impact properties of the aromatic carbonate resins.

Certain compositions of the invention having somewhat higher levels of either polyolefin and/or aliphatic sulfonates also exhibit improved processing as compared to compositions containing only the polyolefin at lower levels.

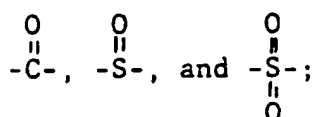
The aromatic carbonate resins of the instant invention include the polycarbonate resins and the copolyester-carbonate resins. The polycarbonate resins are conventional well known materials which are generally commercially available or may be readily prepared by known methods. These polycarbonates, as well as methods for their preparation, are described, inter alia, in U.S.-A-3,161,615, 3,220,973, 3,312,659, 3,312,660, 3,313, 777, 3,666,614 and 3,393,672. The polycarbonates may be prepared by a variety of known methods, including the interfacial polymerization process which involves the coreaction of at least one dihydric phenol with a carbonate precursor. The polycarbonate resins contain at least one recurring or repeating structural unit represented by the formula



wherein:

R and R¹ are independently selected from monovalent hydrocarbon radicals, monovalent hydrocarbonoxy radicals, and halogen radicals;

W is selected from divalent hydrocarbon radicals, -S-, -S-S-, -O-,



n and n¹ are independently selected from integers having a value of from 0 to 4 inclusive;
and b is either zero or one.

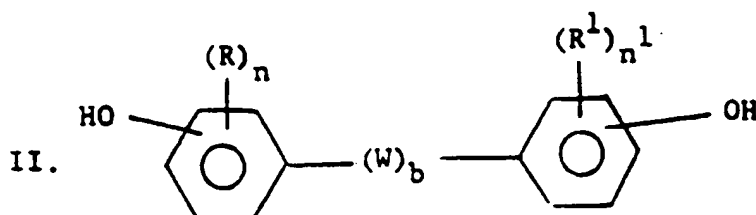
The monovalent hydrocarbon radicals represented by R and R¹ include the alkyl, cycloalkyl, aryl, aralkyl and alkaryl radicals. The preferred alkyl radicals are those containing from 1 to about 12 carbon atoms. The preferred cycloalkyl radicals are those containing from 4 to 8 ring carbon atoms. The preferred aryl radicals are those containing from 6 to 12 ring carbons, i.e., phenyl, biphenyl, and naphthyl. The preferred aralkyl and alkaryl radicals are those containing from 7 to about 14 carbon atoms.

The preferred halogen radicals represented by R and R¹ are chlorine and bromine.

The monovalent hydrocarbonoxy radicals represented by R and R¹ may be represented by the formula -OR² wherein R² is a monovalent hydrocarbon radical of the type described hereinafore. Preferred hydrocarbonoxy radicals are the alkoxy and aryloxy radicals.

The divalent hydrocarbon radicals represented by W include the alkylene, alkylidene, cycloalkylene, and cycloalkylidene radicals. The preferred alkylene radicals are those containing from 2 to 20 carbons. The preferred alkylidene radicals are those containing from 1 to 20 carbons. The preferred cycloalkylene and cycloalkylidene radicals are those containing from 6 to 16 ring carbon atoms.

Typically, the dihydric phenols utilized in the preparation of the polycarbonate resins may be represented by the general formula



wherein R, R¹, n, n¹, W and b are as defined hereinafore.

Some illustrative non-limiting examples of dihydric phenols falling within the scope of Formula II include:

- 2,2-bis(4-hydroxyphenyl)propane (bisphenol-A);
- 2,2-bis(3,5-dibromo-4-hydroxyphenyl)propane;
- 2,2-bis(3,5-dimethyl-4-hydroxyphenyl)propane;
- 2,2-bis(3-bromo-5-methyl-4-hydroxyphenyl)propane;
- 1,1-bis(4-hydroxyphenyl)cyclohexane;
- 1,1-bis(4-hydroxyphenyl)cyclododecane;
- 1,1-bis(3,5-dimethyl-4-hydroxyphenyl)cyclododecane;
- 1,1-bis(4-hydroxyphenyl)decane;

1,4-bis(4-hydroxyphenyl)butane;
 bis(4-hydroxyphenyl)methane;
 4,4'-thiodiphenol; and
 bis(4-hydroxyphenyl)ether.

5 Other dihydric phenols which are useful are described in U.S.-A-2,998,835, 3,028, 365 and 3,334,154.

The carbonate precursor may be a carbonyl halide, a carbonate ester, or a bishaloformate. The carbonyl halides may be carbonyl bromide, carbonyl chloride, or mixtures thereof. The carbonate esters may be diphenyl carbonate; di(halophenyl)carbonate such as di(bromophenyl) carbonate, di(chlorophenyl)-carbonate, and di(tribromophenyl)carbonate; di(alkylphenyl)carbonates such as di(tolyl)carbonate; di-
 10 (naphthyl)carbonate; chlorophenyl chloronaphthyl carbonate; and phenyl tolyl carbonate. The bishaloformates that can be used include the bishaloformates of dihydric phenols such as the bischloroformates of bisphenol-A and hydroquinone; and the bis-haloformates of glycols such as the bischloroformates of ethylene glycol, neopentyl glycol, and polyethylene glycol. The preferred carbonate precursor is carbonyl chloride, also known as phosgene.

15 Among the processes used for the preparation of the polycarbonates are the pyridine process, the interfacial polymerization process, transesterification, and melt polymerization. A convenient process for the preparation of the polycarbonate resins is the interfacial polymerization process. This process utilizes two different solvent media which are immiscible. One solvent medium is an aqueous basic medium. The other solvent medium is an organic medium such as methylene chloride which is immiscible with said aqueous
 20 medium. Also employed in the interfacial polymerization process are molecular weight regulators which control the chain length or molecular weight of the polymer by a chain terminating mechanism, and catalysts. The molecular weight regulators are well known in the art and include, but are not limited to, phenol itself, p-tertiarybutyl phenol, and chroman-I. The catalysts are also well known in the art and include, but are not limited to, tertiary amines such as triethylamine, quaternary ammonium compounds such as tetraethylammonium bromide, and quaternary phosphonium compounds such as n-butyltriphenyl
 25 phosphonium

Also included with the scope of the term polycarbonates are the randomly branched thermoplastic polycarbonates wherein a branching agent, which is generally a polyfunctional aromatic compound, is reacted with the dihydric phenol and the carbonate precursor. These polyfunctional aromatic compounds
 30 are used in minor amounts, i.e., amounts effective to provide branching, and contain at least three functional groups which may be carboxyl, carboxylic anhydride, haloformyl, and mixtures thereof. Some illustrative non-limiting examples of these aromatic polyfunctional compounds which may be employed as branching agents include trimellitic anhydride, trimellitic acid, trimellityl trichloride, 4-chloroformyl phthalic anhydride, pyromellitic acid, pyromellitic dianhydride, mellitic acid, nellitic anhydride, trimesic acid, and benzophenonetetracarboxylic acid.
 35

The copolyester-carbonate resins are well known in the art and are described along with methods for their preparation in U.S.-A-3,169,121, 4,238,596, 4,156,069 and 4,238,697.

Briefly stated the high molecular weight thermoplastic aromatic copolyester-carbonates comprise recurring carbonate groups, carboxylate groups, and aromatic carbocyclic groups in the polymer chain in
 40 which at least some of the carbonate groups and at least some of the carboxylate groups are bonded directly to the ring carbon atoms of the aromatic carbocyclic groups. These copolyester-carbonate resins contain ester bonds and carbonate bonds in the polymer chain, wherein the amount of the ester bonds is in the range of from 25 to 90 mole percent, preferably from 35 to 80 mole percent. For example, 5 moles of bisphenol-A reacting completely with 4 moles of isophthaloyl dichloride and one mole of phosgene would
 45 give a copolyester-carbonate of 80 mole percent ester bonds.

These copolyester-carbonates may be readily prepared by the interfacial polymerization process by the reaction of (i) at least one dihydric phenol, (ii) a carbonate precursor, and (iii) an ester precursor. The dihydric phenols and the carbonate precursors are of the type described hereinafore. The ester precursor may be a difunctional carboxylic acid or, preferably, its ester forming reactive derivative such as a diacid
 50 halide, e.g., isophthaloyl dichloride, terephthaloyl dichloride, and mixtures thereof. Some useful difunctional acids are set forth in U.S.-A-3,169,121.

The preferred copolyester-carbonate for impact purposes are those having an ester content of greater than 50 percent, more preferably greater than 70 percent isophthalate.

The polyolefins which can be employed as impact modifiers are the homopolymers and the
 55 copolymers. Preferred polyolefins are those which are derived from monomers containing from 2 to 10 carbon atoms. Some illustrative non-limiting examples of these polyolefins include polyethylene, polypropylene, polybutylene, polyhexene, polyisobutylene, and ethylenepropylene copolymer.

Methods for the preparation of the polyolefins are abundantly described in the literature and are well

known to those skilled in the art. Polyethylene, for example, can be prepared by various procedures using cationic, anionic or free radical initiating catalysts, with conditions varied to produce a range of molecular weights and densities and various degrees of branching or non-branching. In one procedure, which involves free radical initiation, ethylene gas is polymerized in the presence of a peroxide initiating catalyst at a pressure between 103.35 and 275.6 MPa (15,000 and 40,000 psi) and a temperature between 100°C. and 200°C. to produce a relatively low density polymer, i.e., 0.90 to 0.94 g/cm³.

The polyethylene can also be prepared by low pressure processes effective to attain a polymer of higher molecular weight and a higher density. In one such procedure, known as the Phillips process, ethylene is contacted in an inert solvent slurry of a catalyst such as chromium oxide supported on silica-aluminum, at pressures of 2.75 to 3.44 MPa (400 to 500 psig) and temperatures of 130°C. to 170°C., followed by extraction of the polymer with hot solvent and purification, to produce a polyethylene product having a density between 0.96 to 0.97 g/cm³.

Still other procedures are possible, such as emulsion polymerization in aqueous media in the presence of a peroxy compound, as well as suspension polymerization at low temperatures using a silver salt-peroxide redox system.

Also employable as an impact modifier is polypropylene, a common commercial form of which is isotactic polypropylene. Such polymers can be prepared by anionically initiated reactions using Ziegler type catalysts, e.g., titanium halide such as TiCl₃ in combination with an organometallic co-catalyst such as trialkyl aluminum halide. Polymerization proceeds readily at temperatures between 25°C. and 100°C. to yield a polymer in the form of a slurry of insoluble granular powder.

Copolymers of ethylene and propylene can be prepared using procedures similar to those for polyethylene and other polyolefins; for instance by the polymerization reaction of a mixture of ethylene and propylene in the presence of a Ziegler type catalyst or by free-radical initiation under high pressures.

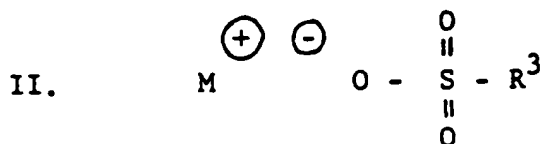
Polymers based on still higher olefins are not as readily available and, therefore, not as preferred. Examples of such higher polyolefins are polymers based on 2-methyl-1-butene, 1-pentene, 4-methyl-1-pentene, and the like. They can be prepared by known procedures including those described in Encyclopedia of Polymer Science and Technology, John Wiley & Sons, Inc., Vol. 9, pp. 440-460, 1965.

The linear low density polyolefins, such as linear low density polyethylene, may be prepared by state of the art polymerization processes such as those described in U.S-A-4,076,698. The polymers may have a density between 0.89 and 0.96 g/cm³ and a controlled concentration of simple side branching as opposed to random branching which distinguishes them from polymers such as high pressure low density polyethylene and high density polyethylene. The preferred range of density is from 0.915 to 0.945 g/cm³. The linear low density polyethylenes are made from ethylene and alpha-olefins of 3 to 8 carbon atoms, e.g., butene-1, octene-1, etc. or mixtures thereof. The comonomer is generally used in minor amounts, e.g., 10 mol % or less of the total amount of monomers. A preferred range is about 1-3 mol %. A particularly useful copolymer is made from ethylene and butene such as, for example, ESCORENE® LPX-15 marketed by Exxon.

Some particularly useful linear low density polyethylenes are those made from ethylene and a C₄-C₇ alpha-olefin, as comonomer. Such linear low density polyethylenes, as well as their use as impact modifiers in polycarbonate resins, are described in U.S-A-4,563,502.

Olefin containing copolymers such as olefin acrylates and olefin diene terpolymers can also be utilized as impact modifiers. An example of an olefin acrylate copolymer impact modifier is ethylene ethylacrylate copolymer available from Union Carbide as DPD-6169. Other higher olefin monomers can be employed as copolymers with alkyl acrylates, for example propylene and n-butyl acrylate. The olefins can also be reacted with rubbery dienes so as to form terpolymers of the EPDM family such as ethylene propylene diene terpolymers, for example Epsyn® 704 available from Copolymer Rubber Co.

The anionic aliphatic sulphonates are well known compounds which are commercially available or may be readily prepared by known and conventional methods. These compounds may be represented by



wherein:

R³ is a monovalent aliphatic hydrocarbon radical or substituted monovalent aliphatic hydrocarbon radical; and

M is a cation.

The monovalent aliphatic hydrocarbon radicals represented by R³ include the saturated and the unsaturated aliphatic hydrocarbon radicals. The saturated aliphatic hydrocarbon radicals are the alkyl and cycloalkyl radicals. The unsaturated aliphatic hydrocarbon radicals include the alkenyl radicals. Preferred alkyl radicals are those containing from 1 to 20 carbon atoms. Preferred cycloalkyl radicals are those containing from 4 to 16 ring carbon atoms. Preferred alkenyl radicals are those containing from 2 to 20 carbon atoms and one or two double bonds.

The substituted aliphatic hydrocarbon radicals are those aliphatic hydrocarbon radicals described above which contain substituent groups, preferably from 1 to 3 substituent groups. The substituent groups may be halogen, nitro, amino, and the like.

Particularly preferred monovalent aliphatic hydrocarbon radicals represented by R³ are the alkyl radicals, with those alkyl radicals containing from 1 to 20 carbon atoms being the preferred alkyl radicals.

The cation represented by M may generally be any of the known cations. However, the metal cations, particularly the alkali and alkaline earth metals, are the preferred cations, particularly sodium.

Particularly useful aliphatic sulphonates are those available from American Hoechst Corp. under the designation HOSTASTAT®HS I. These are in the form of a granular powder having a maximum particle size of 5 mm and are the sodium salt of a mixture of C₁₂ to C₁₈ aliphatic hydrocarbons.

The amount of aliphatic sulphonate used is critical and is an amount which is effective to improve the impact properties of the aromatic carbonate resin/impact modifier blends, but insufficient to substantially deleteriously affect, to a substantial degree, substantially most of the other advantageous properties of the resin. That is to say, an amount which when combined with the impact modifier improves or enhances the impact property improving characteristics thereof, i.e., an impact property enhancing amount. This enables the impact properties of the resin to be improved while using less of the impact modifier. Generally, this amount of sulphonate is from 0.5 to 2.5 weight %, and more preferably from 0.75 to 2 weight %, based on the total amounts of sulphonate and carbonate resin present.

The amount of polyolefin present in the instant compositions is an amount which, when used in conjunction or combination with the aliphatic sulphonate, is effective to improve the impact properties of the aromatic carbonate resin. Generally, this amount should be at least 1 weight percent, preferably at least 2 weight percent. The amount of polyolefin present should not exceed 10 weight percent, based on the amounts of polyolefin and aromatic carbonate resin present.

The presence of at least about 4 weight percent of polyolefin is needed to notice a significant improvement in impact properties when the polyolefin is used alone. In the compositions of the present invention an improvement in impact properties of the aromatic carbonate resin is generally noticeable at amounts as low as one weight percent of polyolefin and is significant at amounts of at least about 2 weight percent.

The compositions of the instant invention may optionally contain the commonly known and used additives for aromatic carbonate resin such as fillers such as glass, talc, mica, clay; antioxidants; colorants; ultraviolet radiation stabilizers such as the benzophenones, benzotriazoles, and cyanoacrylates; mold release agents; hydrolytic stabilizers such as the epoxides; color stabilizers; and flame retardants such as the alkali and alkaline earth metal salts of organic sulfonic acids which are described, inter alia, in U.S.-A-3,933,734, 3,931,100, 5,978,024, 3,948,851, 3,926,908, 3,919,167, 3,909,490, 3,953,396, 3,953,399, 3,917,559, 3,951,910, 3,940,366 and 3,775,367.

In order to more fully and clearly illustrate the present invention the following examples are set forth. Comparative examples 1 to 5 illustrate compositions falling outside the scope of the instant invention. They are presented for comparative purposes only.

COMPARATIVE EXAMPLE 1

A blend was prepared by thoroughly mixing 100 parts by weight of a polycarbonate resin comprised of the reaction products of bisphenol-A and phosgene with 2 parts by weight per hundred parts by weight of resin of a linear low density polyethylene. This mixture was fed to an extruder operating at about 265°C. to extrude the mixture into strands and the strands were chopped into pellets. The pellets were then injection molded at about 298°C. into test samples measuring about 5.31 cm x 3.81 cm x 0.3175 cm and 5.39 cm x 3.816 cm x 0.635 cm (2 1/8" x 1 1/2" x 1/8" and 2 1/8" x 1 1/2" x 1/4"). These samples were then tested for their impact strength in accordance with ASTM D256.

The Kasha Index (KI) of this mixture was also determined. The Kasha Index is an indication or

measurement of the processability of the resin mixture. The lower the KI the greater the melt flow rate and, therefore, the better the processability of the resin. Basically, the Kasha Index is a measurement of the melt viscosity of the resin. The procedure for determining the Kasha Index is as Follows: 7 grams of resin pellets, dried a minimum of 90 minutes at 125°C., are added to a modified Tinius-Olsen model T-3 melt indexer; the temperature in the indexer is maintained at at 300°C. and the resin is heated at this temperature for 6 minutes; after 6 minutes the resin is forced through a 0.105 cm (0.04125 inch) radius orifice using a plunger of radius of 0.47 cm (0.1865 inch) and an applied force of 8.03 kg (17.7 pounds); the time required for the plunger to travel 5.08 cm (2 inches) is measured in centiseconds and this is reported as the KI. The higher the KI the higher the melt viscosity of the resin, and, therefore, the more difficult it is to process. The results of this test, as well as the results of the Notched Izod impact strength test are set forth in Table I.

COMPARATIVE EXAMPLE 2

The procedure of Example 1 is substantially repeated except that 3 parts by weight of linear low density polyethylene are mixed with 100 parts by weight of polycarbonate resin.
The KI and Notched Izod test results are set forth in Table I.

COMPARATIVE EXAMPLE 3

The procedure of Example 1 is substantially repeated except that 4 parts by weight of linear low density polyethylene are mixed with 100 parts by weight of polycarbonate resin.
The KI and Notched Izod test results are set forth in Table I.

COMPARATIVE EXAMPLE 4

A blend was prepared by thoroughly mixing 100 parts by weight of the polycarbonate resin of Example 1 and 1 part by weight of an aliphatic sulphonate (HOSTASTAT®HS 1 of American Hoechst Corp.). Test samples were prepared in accordance with the procedure of Example 1. The Notched Izod impact strength and the KI were determined, and the results are set forth in Table I.

COMPARATIVE EXAMPLE 5

The procedure of Example 4 is substantially repeated except that 3 parts by weight of the aliphatic sulphonate of Example 4 were mixed with 100 parts by weight of the polycarbonate resin of Example 1.
The KI and Notched Izod impact strengths were determined, and the results are set forth in Table I.
The following examples illustrate the compositions of the present invention.

EXAMPLE 6

A blend was prepared by thoroughly mixing 100 parts by weight of the polycarbonate resin as used in Example 1, 2 parts by weight of the linear low density polyethylene as used in Example 1, and 1 part by weight of the aliphatic sulphonate as used in Example 4. Test samples were prepared substantially in accordance with the procedure of Example 1.
The KI and Notched Izod impact strengths were determined and the results are set forth in Table I.

EXAMPLE 7

A blend was prepared substantially in accordance with the procedure of Example 6 except that 100 parts by weight of polycarbonate resin, 4 parts by weight of linear low density polyethylene, and 1 part by weight of aliphatic sulphonate were used.
The KI and Notched Izod impact strengths were determined and the results are set forth in Table I.
The following example illustrates a composition falling outside the scope of the instant invention as it contains an amount of aliphatic sulphonate which falls outside the scope of the instant invention, i.e., greater than 2.5 weight percent.

EXAMPLE 8

A blend was prepared substantially in accordance with the procedure of Example 6 except that 100 parts by weight of the polycarbonate resin, 3 parts by weight of the aliphatic sulphonate, and 3 parts by weight of the linear low density polyethylene were used.

The KI and Notched Izod impact strengths were determined and the results are set forth in Table I.

TABLE I

| Example No. | 1 | 2 | 3 | 4 | 5 | 6*** | 7*** | 8 |
|---|--------------------------|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|
| COMPOSITION (parts by weight) | | | | | | | | |
| polycarbonate | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| LLDPE (LPX-15)* | 2 | 3 | 4 | 0 | 0 | 2 | 4 | 3 |
| Hostacast®HS-1 | 0 | 0 | 0 | 1 | 3 | 1 | 1 | 3 |
| 3.2 mm Notched Izod (Kg. cm/cm) J/cm | 8.33 ¹⁰⁰ | 8.00 ¹⁰⁰ | 8.58 ¹⁰⁰ | 8.48 ¹⁰⁰ | 2.67 ⁰ | 8.91 ¹⁰⁰ | 8.11 ¹⁰⁰ | 5.81 ¹⁰⁰ |
| | (84.9 100) ^{**} | (81.6 100) | (85.4 100) | (86.5 100) | (27.2 ⁰) | (89.8 100) | (82.7 100) | (59.3 100) |
| 6.4 mm Notched Izod (Kg. cm/cm) J/cm | 1.55 ⁰ | 1.86 ⁰ | 2.45 ⁰ | 2.03 ⁰ | 0.26 ⁰ | 6.88 ¹⁰⁰ | 6.24 ¹⁰⁰ | 3.15 ⁰ |
| | (15.8 ⁰) | (19.0 ⁰) | (25.0 ⁰) | (20.7 ⁰) | (2.7 ⁰) | (70.2 100) | (63.6 100) | (62.1 ⁰) |
| KI at 300°C, CSEC | 3150 | 2550 | 2440 | 2850 | 1280 | 3100 | 2330 | 1870 |

* linear low density polyethylene with butene-1 obtained from Exxon Chemical Co.

** The superscript denotes percent of bars which failed (broke) in a ductile manner.

*** Examples within the scope of the instant invention.

As illustrated by the data in Table I the conventional prior art blends containing linear low density polyethylene (Examples 1-3), exhibit improved impact properties as compared with polycarbonate resin alone. The addition of minor amounts, i.e., 1 part by weight, of the aliphatic sulphonate to blends containing a polycarbonate resin and a linear low density polyethylene, dramatically improves the thick section impact properties of these compositions (Examples 6 and 7), changing the break or failure mode of the test pieces from brittle to ductile. The addition of only the aliphatic sulphonate to the polycarbonate resin (Examples 4 and 5) does not change the break mode of the thick section test samples, i.e., the break mode is still brittle as in Examples 1-3.

As illustrated by the data for Example 8 exceeding the critical upper limit of the concentration of the aliphatic sulphonate in the compositions results in an actual decrease or downgrading of the impact properties in thick sections of blends containing linear low density polyethylene and polycarbonate resin.

Claims

1. A composition comprising:
 - (a) an aromatic carbonate resin,
 - (b) 1 to 10%, based on the total weight of (a) and (b) of a polyolefin, and
 - (c) 0.5 to 2.5%, based on the total weight of (a) and (c) of an anionic aliphatic sulphonate.
2. The composition of claim 1 wherein said aromatic carbonate resin is an aromatic polycarbonate resin.
3. The composition of claim 1 wherein said aliphatic sulphonate is an alkyl sulphonate.
4. The composition of claim 1 wherein said polyolefin is a linear low density polyethylene.
5. The composition of claim 1 wherein said aromatic carbonate resin is a copolyester carbonate resin.

Revendications

1. Composition comprenant :
 - (a) une résine de carbonate aromatique,
 - (b) 1 à 10 % d'une polyoléfine relativement au poids total de (a) et de (b) et
 - (c) 0,5 à 2,5 % d'un sulfonate aliphatique anionique relativement au poids total de (a) et de (c).
2. Composition selon la revendication 1, dans laquelle ladite résine de carbonate aromatique est une résine polycarbonate aromatique.
3. Composition selon la revendication 1, dans laquelle ledit sulfonate aliphatique est un alkylsulfonate.
4. Composition selon la revendication 1, dans laquelle ladite polyoléfine est un polyéthylène linéaire basse densité.
5. Composition selon la revendication 1, dans laquelle ladite résine de carbonate aromatique est une résine copolyester-carbonate.

Patentansprüche

1. Zusammensetzung enthaltend:
 - a) ein aromatisches Carbonatharz,
 - b) 1 bis 10 % eines Polyolefins, bezogen auf das Gesamtgewicht von (a) und (b) und
 - c) 0,5 bis 2,5 % eines anionischen aliphatischen Sulfonats bezogen auf das Gesamtgewicht von (a) und (c).
2. Zusammensetzung nach Anspruch 1, worin das aromatische Carbonatharz ein aromatisches Polycarbonatharz ist.
3. Zusammensetzung nach Anspruch 1, worin das aliphatische Sulfonat ein Alkylsulfonat ist.

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4. Zusammensetzung nach Anspruch 1, worin das Polyolefin ein lineares Polyäthylen niederer Dichte ist.
5. Zusammensetzung nach Anspruch 1, worin das aromatische Carbonatharz ein Copolyestercarbonatharz ist.

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